

CHATHAM, MASSACHUSETTS

RECONNAISSANCE REPORT  
NAVIGATION IMPROVEMENTS  
CHATHAM BARS INLET

ENGINEERING DIVISION RECORD COPY  
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DEPARTMENT OF THE ARMY  
NEW ENGLAND DIVISION, CORPS OF ENGINEERS  
WALTHAM, MASSACHUSETTS  
SEPTEMBER 1979



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE  
ECOLOGICAL SERVICES  
P. O. BOX 1518  
CONCORD, NEW HAMPSHIRE 03301

October 4, 1978

Colonel John P. Chandler  
Division Engineer  
New England Division, Corps of Engineers  
424 Trapelo Road  
Waltham, Massachusetts 02154

Dear Colonel Chandler:

This letter is in response to a request from Mr. Steve Onysko of your staff relating to possible shellfish benefits for federal projects at Chatham Bar and Pleasant Bay, Cape Cod, Massachusetts. Mr. Onysko had contacted our office to inquire if the shellfish benefits from our Madaket Harbor report could be used for preliminary planning purposes in these two areas on similar types of projects. Based on our cursory examination of the projects as proposed by Mr. Onysko, we would be very hesitant to apply Madaket Harbor shellfish benefits to the areas in question at Chatham Bar and Pleasant Bay without first undertaking some detailed investigation on these projects.

The proposal to construct a dike between Monomoy Island and the Mainland at Chatham would conflict with the wilderness management concept established for Monomoy National Wildlife Refuge. Monomoy Island was designated as a wilderness area under provisions of the 1964 Wilderness Act on October 23, 1970. If the Chatham Bar study proceeds with major structural alternatives such as the dike concept, then close coordination between our offices should be maintained to insure that an acceptable project is planned. Our initial reaction to the dike proposal connecting Monomoy Island to the mainland is negative.

Sincerely yours,

Gordon E. Beckett  
Supervisor



UNITED STATES  
DEPARTMENT OF THE INTERIOR  
FISH AND WILDLIFE SERVICE

GREAT MEADOWS NATIONAL WILDLIFE REFUGE  
191 SUDBURY ROAD  
CONCORD, MASSACHUSETTS 01742  
Telephone (617) 369-5518

November 27, 1978

Mr. Steve Oryske, Coastal Development  
Dept. of the Army  
New England Div., Corps of Engineers  
424 Trapelo Road  
Waltham, MA 02154

Dear Mr. Oryske:

Per our telephone conversation of November 22 I am sending you copies of Public Law 91-504, Designation of Wilderness Areas within National Wildlife Refuges and partial copies of House of Representatives Report to accompany HR 19007 and Senate Report to accompany S-1652. The copy of the Senate Report is very poor. The paragraph of particular interest to you is on the second page, bracketed in red, and reads as follows:

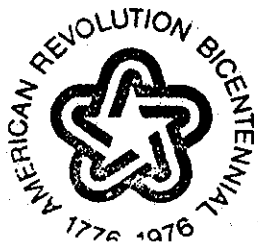
"The Department of the Army is currently studying the feasibility of a project for navigation for Pleasant Bay and tributary waters, Massachusetts. The proposed project would include the closing of the gap between Monomoy Island and Nauset Beach. The wilderness proposal would not preclude the planning and construction of this project. The Department of Interior would expect to work closely with the Department of the Army if the project is authorized."

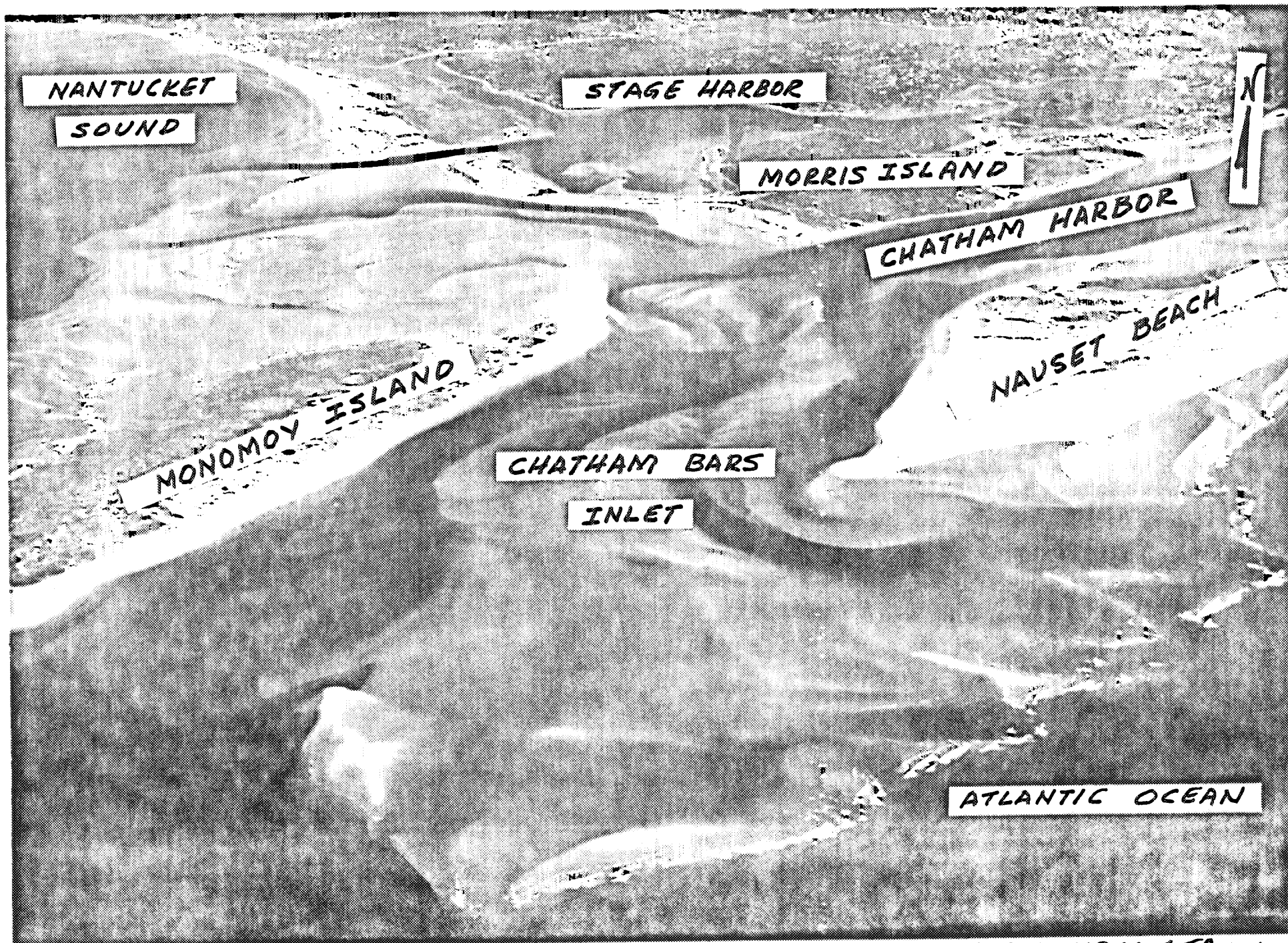
I would appreciate any available materials concerning your current studies and proposal to close the gap between Monomoy Island and Morris Island.

Sincerely,

*for* David L. Beall  
Refuge Manager

DLB:ebn  
Attachments





76-603-57C — CHATHAM BARS INLET, CHATHAM, MA. LKG. NW 3 JUN 1976 Kelsoy

Reconnaissance Report  
Navigation Improvements  
Chatham Bars Inlet  
Chatham, Massachusetts

1. Authority

This report was authorized by the Office of the Chief of Engineers, DAEN-CWP-A, on 5 April 1978, in accordance with Section 12, P.L. 93-251 (Deauthorization of Authorized Projects) and ER 1105-2-82.

2. Purpose and Extent of the Study

Navigation improvements in the Chatham Bars Inlet, along with a breakwater, interior channels and anchorages, were recommended in the Pleasant Bay Survey Report dated November 1968, and were subsequently authorized by the River and Harbor Act of 1970. However, funds were never appropriated, for design or construction as local interests could not provide their share of the cost of the overall project. The authorized project became eligible for deauthorization in December 1978. There is a strong desire for navigation improvements in the Chatham Bars Inlet by local fishermen, but to a smaller scope and cost than the authorized project. However, there are serious questions concerning the economic justification for providing less than authorized navigation improvements.

This report, therefore, was undertaken at the request of Congressman Studds and local interests to investigate lesser alternative inlet improvements and to determine if they would be feasible and economically justified. If the improvements are economically justified, further detailed studies would be undertaken.

The study area in this report includes the Chatham Bars Inlet, Chatham Harbor, Nauset Beach, the breach between Morris and Monomoy Islands and the entrance to Chatham Stage Harbor.

3. Description

Chatham Bars Inlet is located in the town of Chatham (Barnstable County) Massachusetts at the "elbow" of the compound spit of Cape Cod. It is a highly scenic, shallow, hazardous, natural coastal inlet connecting Chatham Harbor and Pleasant Bay to the north with the Atlantic ocean to the south and east. (See Plate 1) It is bounded on the north by Chatham Harbor, on the east by Nauset Beach and the Atlantic Ocean, on the south by Monomoy Island and Nantucket Sound, and on the west by Nantucket Sound and by Harding Beach and Morris Island which separate the inlet from Chatham Stage Harbor about one mile to the west. It is located about 75 miles southeast of Boston, 90 miles east of Providence, and 225 miles east of New York City.

In 1868 the inlet was located about four miles to the north opposite Allen Point at the entrance to Pleasant Bay. Since that time it has migrated almost four miles southward, to its present location. Sandy materials erode off the Cape Cod headlands to the north and move in a southerly direction due to predominant wave forces thereby providing a source of material for the barrier spit separating Pleasant Bay from the Atlantic Ocean. Finer grained material moves as far south as the tip of Monomoy Island, a distance of about seven miles from the present Chatham Bars Inlet.

Chatham Bars Inlet is used primarily by commercial fishing vessels, during favorable tides and weather. Recreational boating is severely restricted due to the treacherous waters and shifting shoals. Shallow draft recreational boats, however, use Pleasant Bay and adjoining ponds. In 1938, the inlet was about opposite Tom's Neck, one-half mile south of the Chatham Lighthouse. Monomoy Island was connected to Morris Island and was continuous all the way to its tip. As Nauset Beach migrated to the south, the natural inlet also migrated to the south. The commercial fishermen were able to navigate the migrating inlet without too much difficulty until the winter storms of 1957-1958, when a breach occurred between Morris and Monomoy Island. Since that time, the breach has widened and shoals in Chatham Bars Inlet have become progressively worse.

#### 4. Baseline Conditions

The contiguous towns of Chatham, Orleans to the north and Harwich to the west were settled in the latter part of the 17th century. Some of their earliest industries were agriculture, shellfishing, cod-fishing, saltworks, whaling, shipbuilding and also the manufacture of shoes and boots. These industries, with the exception of fishing, phased out of operation and the economy of the area is now dependent upon the fisherman, the vacationer, and the tourist. Today the town's principal source of income comes from serving many thousands of summer visitors. A report, "The Fishing Industry of Chatham and its Importance to the Town," published in August 1978 by the Massachusetts Institute of Technology, Department of Urban Studies and Planning, states that 17 percent of Chatham's employment is dependent on the fishing industry.

Historically, when the barrier beach migrates past Morris Island, the tide range in the bay becomes about half that of the ocean and a new natural inlet breaks through the barrier beach into the bay, usually during a severe storm. The inlet again migrates to the south and another cycle is repeated. The Chatham Bars Inlet has gone through two or three of these large scale inlet evolution cycles since 1620, (Goldsmith 1972).

#### 5. Bridges

There are no bridges crossing the waterway area under study.

RECONNAISSANCE REPORT  
NAVIGATION IMPROVEMENTS  
CHATHAM BARS INLET  
CHATHAM, MASSACHUSETTS

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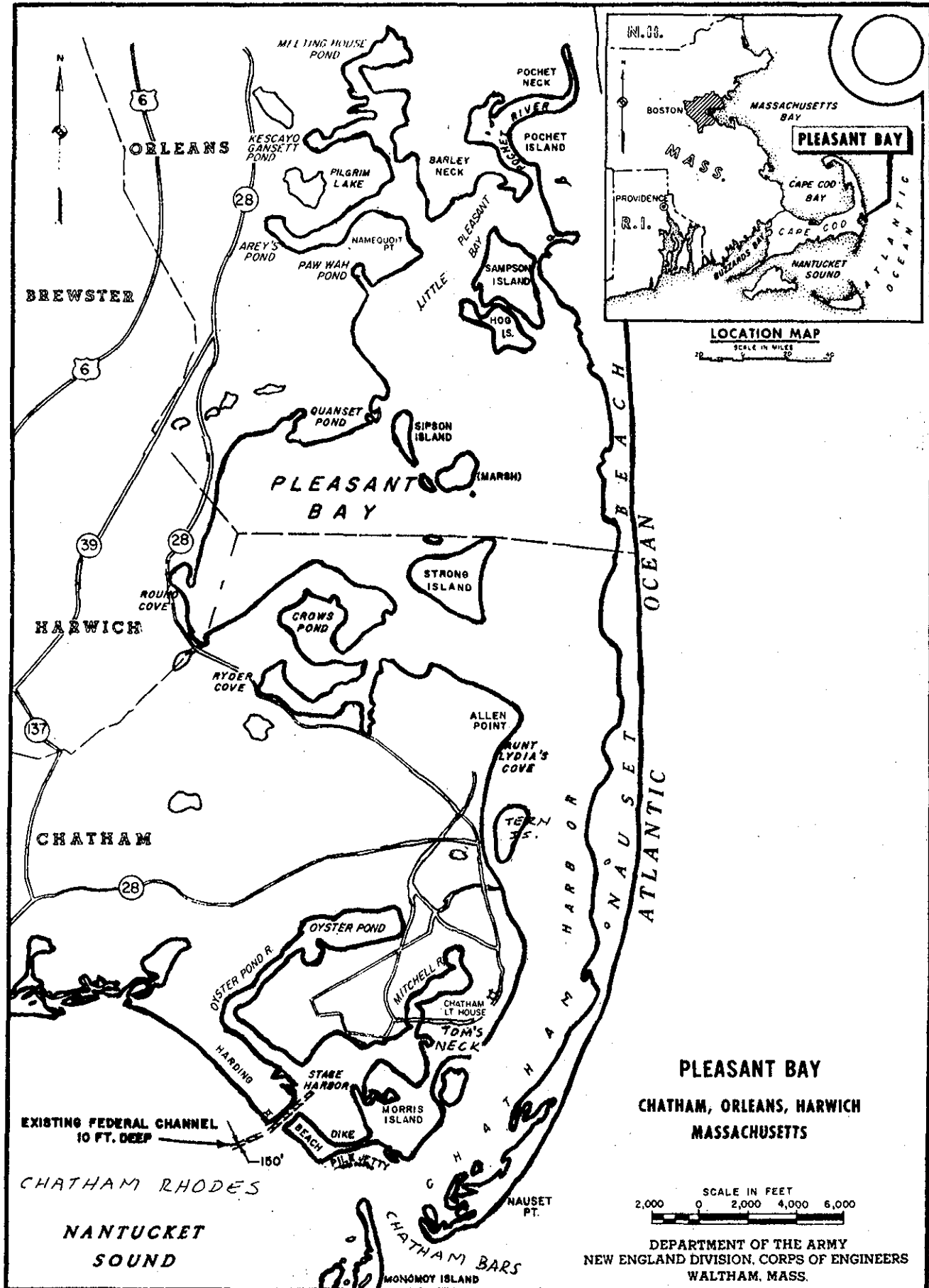
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REPORT MAPS

Plate 1	Pleasant Bay	Following Page 2
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APPENDICIES

Appendix A	Pertinent Correspondence
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## 6. Existing Projects

The Pleasant Bay Project, as authorized by the River and Harbor Act of 1970, provided for a 1,000-foot wide stabilized inlet through Nauset Beach; a 200-foot wide, 20-foot deep inlet channel into Chatham Harbor; a 200-foot wide, 6-foot deep channel into Nantucket Sound; channels and anchorages extending from the inlet to the upper reaches of Pleasant Bay, all to a depth of 6 feet; and dune restoration along Nauset Beach. Local interests have not been able to provide their share of the cost of construction, therefore, the project has been inactive.

There is an existing Federal project in Chatham Stage Harbor about one mile to the west.

The original project was authorized by the River and Harbor Act of September 1890. The River and Harbor Act of 1945 provided modifications for a channel 10 feet deep, 150 feet wide from Chatham Roads around Harding Beach and into the upper harbor, a distance of 2.1 miles. A supplemental Design Memorandum approved in October 1964 provided for relocating the channel through Harding Beach, about a half mile west of the original inlet, and construction of a sand dike 2,500 feet long, from Harding Beach to Morris Island across the natural harbor mouth; construction of a timber pile jetty, 1,500 feet long near the dike; and two stone jetties near the channel relocation, the west jetty 500 feet long and the inner jetty 350 feet long.

Relocation of the 10-foot deep channel through Harding Beach, construction of the sand dike and the timber pile jetty; and the 200 feet of the west jetty were completed in July 1965. Extension of 300 feet of the west jetty was completed in December 1967. No work has been done on the 350-foot inside jetty. Maintenance dredging of the entrance channel has been required through 1978.

## 7. Terminal and Transfer Facilities

The Chatham Municipal Wharf, popularly known as the Chatham Fish Pier, is the only commercial transfer facility in Chatham Harbor and is owned by the town of Chatham. It is located in Aunt Lydias Cove, it consists of a solid fill wharf and a wood pile bulkhead, with concrete decking and a fish packing building. Freshly caught fish is iced and shipped from the pier directly to Boston, New York, and the Philadelphia area by refrigerated trucks. One small privately owned marina is located just south of the Chatham light.

## 8. Vessel Traffic

There are 114 commercial fishing boats located in Chatham Harbor of varying sizes from 16 to 48 feet in length and with drafts of 2 feet to 7.5 feet. In addition, there are 7 lobster boats and 3 party fishing boats about 40 feet in length with drafts up to 5 feet. Approximately 20,000 trips are made per year. Approximately 8,000

passengers are carried by the party boats per year. The U.S. Coast Guard maintains a radar-equipped station at Chatham Light with a compliment of approximately 24 men and several rescue vessels. A 44-foot vessel is berthed on the south side of the Chatham Municipal Wharf and has a 3.5 ft. draft.

#### 9. Existing and Prospective Commerce

The focus of water-oriented commercial activity in Chatham is at the Chatham Municipal Wharf in Aunt Lydias Cove. The existing commodities are fresh fish, lobster, and shellfish. The basic method of catching fresh fish is by longline, handline, and Scottish Seining.

Longline fishing is done by baiting hooks spaced 6 feet apart on approximately a 3,500 foot line weighted to the bottom and located by surface buoys. The line is usually kept in a "wash tub" on deck. Most boats set four lines and carry one extra as a spare.

Handline fishing is done with a "jig" and is called "jigging". A shiny weighted jig with a treble hook is jigged up and down about 6 feet above the bottom until the fish strikes. Some jig lines have several hooks.

Scottish Seining is a relatively new and experimental method of automated fishing in the Chatham area and can be done with one or two boats trailing large nets behind them.

Lobster fishing is basically a one-man, one-boat type operation. Some boats carry one or two extra men when setting or removing pots for the season or when the catch is unusually heavy.

Chatham is one of the most productive shellfish areas in Massachusetts. The kinds of shellfish harvested are quahogs (hard shell clams), soft shell clams (steamers), scallops, oysters and mussels. In addition to licensed commercial shellfishermen, a large number of family and nonresident permits are issued annually.

No new commerce is anticipated in the area in the near future.

#### 10. Problem Identification

Around 1868 the Chatham Bars inlet was located opposite Allen Point. Since that time, it has migrated southwards, about 225-250 feet per year to opposite the tip of Morris Island. After the winter storms beached Monomoy Island in 1957-1958, just below Morris Island, the Chatham Bars Inlet began to shoal badly and the depth of water was gradually reduced from about 18-20 feet to about 4-5 feet as the southerly littoral drift material was dispersed into Chatham Bars Inlet and through the Monomy Breach into Nantucket Sound. Continual shoaling and shifting natural channels make navigation through the inlet hazardous.

Offshore entrance bars are now 2-3 feet below water and in some areas are well above the low water level. Fishermen fear to navigate the shifting channels and shallow bars at low water, and tidal delays of up to several hours are common for the larger draft vessels. The vessels must now travel further south to get through the inlet and more time is required to get to and from the fishing grounds. Breaking waves over the inlet bars from distant storms keeps the fishermen in port even on good days. The tide levels in Chatham Harbor and the upper reaches of Pleasant Bay have been reduced by about a foot since 1930 and ebb currents are no longer sufficient to scour a natural deep channel to the ocean. In addition, the flood and ebb tides also flow between Chatham Roads and Chatham Harbor, through the continually widening breach on Monomoy Island, thereby causing cross current in the Chatham Bars Inlet.

The Monomoy Breach eventually widened to over 4,000 feet at MHW and the sand almost completely filled in the existing Federal channel into Chatham Stage Harbor by early 1962, necessitating emergency dredging of 35,000 cubic yards of sand by the town of Chatham in August 1962.

In 1965 the Federal channel was modified and relocated further west, directly through Hardings Beach. Since that time sand has continually moved westward through the widening Monomoy Breach and contributed to the shoaling of the entrance channel and relocated inlet. Navigation into Stage Harbor has thus been impeded and maintenance dredging was required in 1970, 1973, 1974, 1976, 1977, and 1978. It is anticipated that the shoaling will continue if the breach is not repaired.

Another breach in Monomoy Island occurred just north of Inward Point about 3 miles south of Morris Island, during the storm of 6-7 February 1978. A Landsat 3RBV image taken on 9 March 1978 indicates the breach had widened to 490.5 meters, or almost 1500 feet. The effect of the latest breach was not evaluated in this study.

#### 11. Studies by Others.

Local interests are concerned, not only with the navigational difficulties in the inlet, but also with the ecology and environment of the overall area. They have made a number of their own studies and taken action to preserve the dunes.

The Chatham Conservation Commission funded a "Survey of the History and Dynamics of the Chatham Barrier Beach System," (Giese, 1978) to assist their planning and conservation efforts. The town of Orleans funded a "Shellfish Inventory Study" in their portion of Pleasant Bay in the mid-1960's.

Both the towns of Chatham and Orleans have active shellfish conservation programs administered by their shellfish wardens. The town of Orleans has a full time marine biologist engaged in a number of on going shellfish studies and experiments throughout the upper reaches of Pleasant Bay and in Nauset Harbor.

Chatham and Orleans have enacted "Rules and Regulations" for the outer Nauset Beach and have restricted the number of beach buggies which can use the beach at any one time.

#### 12. Water Power and Other Special Features.

The waterway is tidal. Water power, flood control, and other related subjects are not pertinent to this study.

#### 13. Improvements Desired.

The primary improvements desired are a safer inlet channel, between 20 to 50 yards wide and 6 to 10 feet deep, to reduce hazards and eliminate tidal delays. Other desires are better navigational aids, and more mooring and dock space in Chatham Harbor.

#### 14. Formulation of Alternatives

In formulating alternatives, plans were sought which would provide multiple purpose objectives, consistent with existing regulations and related policies. Particular consideration was given to improvements desired by local interests as well as alternative plans that would provide a reasonably safe navigable inlet at an economical cost. In addition, plans were sought that would minimize adverse effects to the existing ecology and environment of the estuary and bay.

Additional mooring and dock space were not included in the plans of improvement as they are a local responsibility.

Plans were also sought that would utilize existing coastal processes and assist nature to develop a natural inlet or provide an artificial inlet that would respond to natural processes and maintain the navigability into Chatham Harbor over a period of time.

Structural inlet stabilization with rock or armor units, as well as mechanical sand bypassing and periodic dredging, was ruled out due to high construction, operation, and maintenance costs. Proposed inlet location through Nauset Beach was limited to a site about two miles southeast of Aunt Lydias cove in order to minimize changes in temperature and tide levels in the upper bay areas and still provide protection for the commercial fleet near the Chatham Fish Pier Area.

To reduce costs, semistructural and nonstructural plans, such as sand dunes and barrier dikes, and prohibited use by zoning or regulations were investigated. Semistructural or nonstructural alternatives cannot be expected to control the extensive amount of the southerly littoral drift of sand and periodic channel maintenance would only be futile, therefore, it was planned to provide an initial project without future channel maintenance.

## 15. Alternatives Considered.

The alternatives considered included some of those investigated in the original Pleasant Bay Report of November 1968 and modifications thereof. Five specific alternative plans were selected for further consideration and economic investigation. They are shown on Plate 2 and are described as follows:

### PLAN A

This plan provides an unstabilized artificial inlet through Nauset Beach, about opposite the Chatham Light. The inlet would be cut through the barrier beach with a hydraulic dredge and the material placed on the backside of the northerly portion of Nauset Beach to fill in overwash areas and reinforce the dunes. The filled in areas would be planted with beach grass. The channel through the inlet would be 200 feet wide, 10 feet deep at MLW, with 1 on 20 sideslopes. The objective of this plan is to provide a navigable inlet closer to the commercial fishing fleet, and allow it to migrate naturally to the south by natural process.

If a natural inlet were created by a storm anywhere north of the artificial inlet, it could be detrimental to the ecology of the bay, as well as to the commercial fishing fleet. Therefore, "snow fences" would be erected to assist in building-up the dunes from the proposed inlet to Little Pochet Island, to prevent future breakthroughs. If the artificial inlet captures the tidal prism of the bay, the inlet would stay open and migrate to the south, as in the past. If it does not stay open, it would eventually fill back in and it is estimated that it would take approximately 40 years to migrate southward to the present location. Historically, after a breach occurred and stayed open, the lower part of Nauset Beach migrated southwestward toward the mainland and Monomoy Island. It is estimated that it would take about 28 years to join the mainland and close the existing breach in Monomoy Island. The required amount of dredging in the artificial inlet would be about 420,000 cy.

Although this plan has considerable merit, there is no reasonable assurance that the artificial inlet would remain open, because of the large volume of net littoral drift available to fill in the new inlet. In addition, a portion of the tidal prism would be diverted into Nantucket Sound and probably would not be available to help maintain the new inlet. For these reasons no maintenance dredging would be provided as part of this plan. The estimated cost of this plan is \$1,912,000.

### PLAN B

Plan B provides an artificial inlet through the barrier beach opposite Chatham Light as described in Plan A, and a sand dike closure between Morris and Monomoy Islands. The top of the sand dike would be at elevation +13.0 feet MLW and 50 feet wide; side slopes would be 1 on 15 to MHW, 1 on 20 to MLW and 1 on 30 below MLW; total length of the dike would be about 6,000 feet; and the side slopes would be planted with beach grass. The sand dike closure would prevent tidal processes from shoaling the

existing Federal navigation channel into Chatham Stage Harbor and would direct the tides into Chatham Harbor and Pleasant Bay, thereby providing more tidal flow to help keep the artificial inlet open or maintain the existing Chatham Bars Inlet, if the new inlet closed. Dune restoration on Nauset Beach, north of the proposed inlet to Little Pochet Island would also be provided. The inlet and lower portion of Nauset Beach would be expected to migrate as described in Plan A.

The sand dike fill material would be dredged from a 100-acre area behind Monomoy Island. The fill would amount to 850,000 cy and includes a 30 percent overfill. There would be no maintenance of the inlet. However, there would be maintenance of the sand dike and beach grass.

Although the full tidal prism will be directed into and out of the bay, it is uncertain if the new inlet will stay open. There is also a possibility that both inlets would stay open and both would be too shallow for safe passage for a long period of time. The estimated cost of this plan is \$4,856,000.

#### PLAN C

This plan consists of an artificial inlet as described in Plan A, and a sand dike between the southerly tip of Nauset Beach and Monomoy Island, like the dike described in Plan B. A crossover navigation channel would also be provided from Chatham Harbor to Nantucket Sound, 200 feet wide and 6 feet deep, MLW. It would allow recreational boating between Stage Harbor and Pleasant Bay. The dredged sand from the crossover channel would also be used to construct the sand dike closure.

Additional sand needed for the dike would be obtained from behind Monomoy Island. Dune restoration north of the artificial inlet to Little Pochet Island and south to the sand dike would also be part of the plan. The object of this alternative is to provide an artificial inlet opposite the Chatham Light for the same reasons described in Plans A and B. The purpose of the sand dike closure between Nauset Beach and Monomoy Island would be to protect boating from adverse offshore conditions and reduce the shoaling of the new crossover channel between Chatham Harbor and Nantucket Sound as well as shoaling of the Stage Harbor entrance channel. However, the sand dike would be in a more exposed location and the southerly littoral drift material might not be sufficient enough to maintain the integrity of the dike, thereby negating the protection to the proposed new channel and the Stage Harbor channel. The geomorphology would also respond to the coastal processes as described in Plans A and B. The total length of the dike would be about 5,000 feet and the total amount of sand needed would be 1,125,000 cubic yards which includes a 50 percent overfill. No maintenance of the inlet would be provided, however, maintenance would be provided for the sand dike and grass as in Plan B. The estimated cost of this plan is \$6,656,000.

#### PLAN D

This alternative plan would have no improvements. The objective of this plan is to leave the inlet to the natural coastal processes and let nature eventually create a new breach through Nauset Beach at will. If the new breach stays open, it will continue to widen and the existing Chatham Bars Inlet would probably close. If the breach closed, the existing inlet would stay open. The process would be repeated until a natural inlet channel was created somewhere, either into Chatham Harbor or Pleasant Bay. There is no way of predicting when or where a natural inlet will occur. If multiple inlets occurred through the barrier beach, none of them would probably be deep enough for safe navigation. Of course, this plan would cost nothing.

#### PLAN E

This plan provides a sand dike closure between Morris and Monomoy Islands, as described in Plan B, and an extensive dune restoration program along Nauset Beach about opposite Chatham Light to Little Pochet Island. The object of the plan is to provide a barrier to the tidal flow through the existing Morris-Monomoy breach in order to divert the full tidal prism into Chatham Harbor on the flood cycle and prevent a portion of it from being diverted into Nantucket Sound on the ebb cycle, thereby utilizing the full prism to scour a deeper, natural channel through the Chatham Bars Inlet for navigation purposes. Extensive dune restoration on Nauset Beach would reinforce the barrier beach against overtopping or breakthroughs by storms. The portion of Nauset Beach south of Chatham Light would be left in its natural state with the expectation that a future breakthrough would occur somewhere along that section of the barrier and create a new inlet into Chatham Harbor. If the breach occurred opposite the Chatham Light, it is anticipated that the new natural inlet would be usable over a period of about 25 to 40 years, when the cycle would start over again. The cost of this plan is estimated to be \$3,109,000.

#### PLAN F

This alternative plan relocates the existing fishing fleet to another harbor. The only other harbor on the easterly Cape Cod shoreline directly accessible to the fishing grounds in the Atlantic Ocean is Nauset Harbor, located about 10 NM north of Chatham Bars Inlet. However, Nauset Harbor Inlet is also unstabilized and not only migrates to the south but also migrates to the north, which it is presently doing. Therefore, this inlet would be more treacherous for the Chatham fishing fleet than the Chatham Bars Inlet.

Provincetown and Wellfleet Harbors on Cape Cod Bay are presently overcrowded and shore facilities are minimal with no room for expansion and are further away from the fishing grounds. Other harbors on the south shore of Cape Cod, such as Saquatucket, Harwich Port, and Hyannis are also overcrowded and have limited shore facilities. The boats would also have further to go to reach the fishing grounds.

The only other nearby port is Chatham Stage Harbor on the west side of Morris Island. In addition to being overcrowded with existing fishing and recreational sailboats, its location entails a long trip (around Monomoy Island) to and from fishing grounds. Furthermore, the harbor is frequently icebound in the winter months. Most of the contiguous land is privately-owned and the municipally-owned land is either wetlands or in a conservation trust. Lastly, Chatham Stage Harbor could not accommodate the 114 fishing boats on moorings without the extensive dredging of the shellfish beds for anchorages and construction of new shore facilities which would be costly. No attempt was made to estimate the cost of this alternative because of the strong desire of the fishermen to remain in the local area.

#### 16. Estimates of First Cost and Annual Charges.

The costs of the proposed alternative plans of improvement reflect cost levels as of June 1979. The overall estimated costs include; mobilization and demobilization of dredging and ancillary equipment; dredging; deposition and shaping of dredged material for the sand dike; planting and fertilizing beach grass; navigational aids; and restoring the dunes on Nauset Beach. Maintenance of the beach grass and the sand dikes and navigational aids are included in the overall annual charges. Due to the instability of the inlets, no maintenance dredging is planned.

The estimated costs and annual charges for each alternative is shown in Table 1.

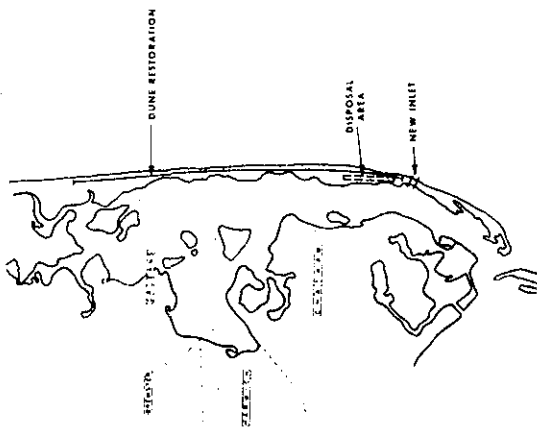
TABLE 1  
ESTIMATED COST AND ANNUAL CHARGES

<u>Plan</u>	<u>First Cost</u>	<u>Annual Charges</u>
A	\$1,912,000	\$170,000
B	4,856,000	457,500
C	6,656,000	797,700
D	0	0
E	3,109,000	305,200
F	(Not Estimated)	(N/A)

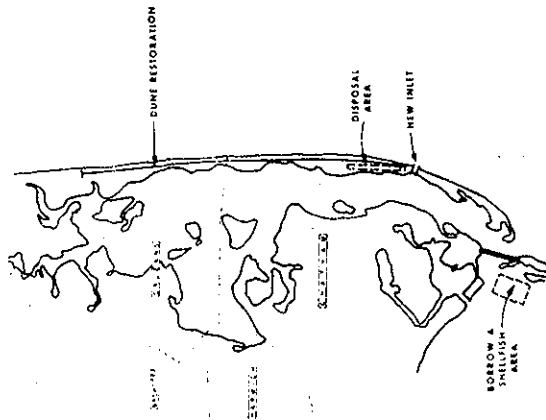
#### 17. Estimates of Annual Benefits

The proposed plan of improvements for the Chatham Bars Inlet would result in benefits to the commercial fishing interests, the Federal Government, the town of Chatham, and recreational boaters.

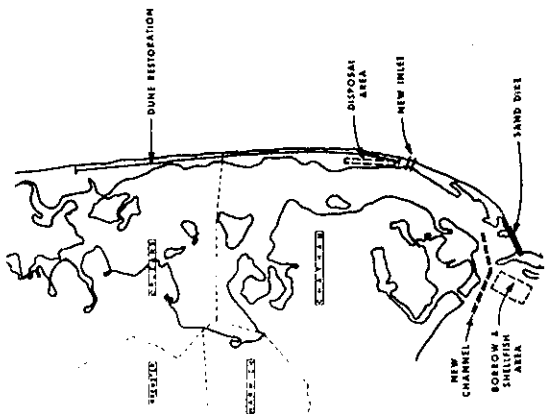
The commercial benefits have been evaluated in terms of increased catch; reduced amount of tidal delays; reduction in boat damages; and reduction of increased transportation cost returning and operating from other ports.



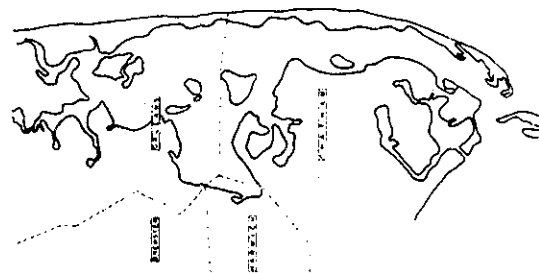
PLAN A



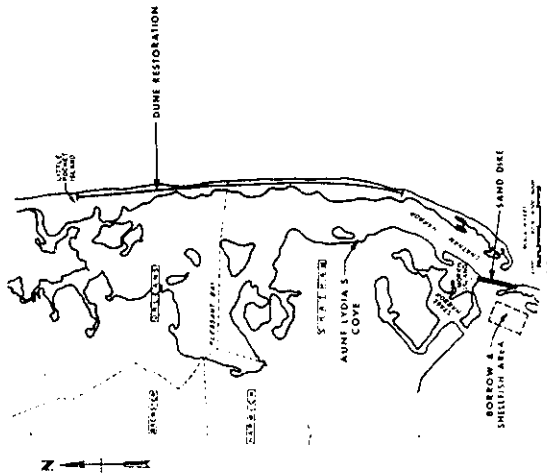
PLAN B



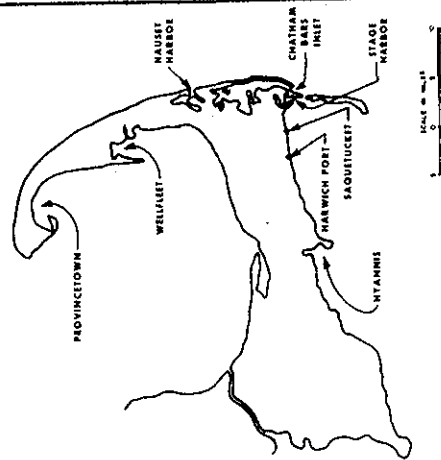
PLAN C



PLAN D



PLAN E  
SELECTED PLAN



PLAN F

CORPS OF ENGINEERS - NEW ENGLAND DIVISION

CHATHAM BARS INLET

ALTERNATIVE PLANS

SEPTEMBER, 1979

The benefit to the Federal Government would be the reduction of the cost of maintenance dredging in the Federal navigation project in the entrance channel to Stage Harbor.

The benefits to the town of Chatham would be through the reduction in costs for making new buoys and relocating and maintaining them.

Recreational benefits were estimated for the boating fleets in Chatham and Stage Harbor. Negative boating benefits would occur when the Morris-Monomoy Island breach is closed.

The benefits are described as follows:

a. Increased Net Income to Fishermen. An estimate of total increase in catch was based on information obtained in discussions with the Chatham Harbormaster, Chatham fishermen, and officials of the National Marine Fisheries Service and U.S. Fisheries Management. The net income is based on an estimated 15% increase in catch directly attributable to the proposed improvements, using June 1979 prices. Operating costs totaling 33% were deducted from the anticipated 15% increase in finfish catch only. No increase in lobster or sea scallop catches were anticipated due to the limited resources. The estimated net increase in income is \$199,520 annually.

b. Boat Damages Prevented. 114 fishing boats in Chatham Harbor pay dockage fees to the town. The number and sizes are shown in Table 2.

TABLE 2  
NUMBER AND SIZE OF FISHING BOATS

<u>No.</u>	<u>Drafts (Ft)</u>	<u>Percent of Total</u>
49	1-3	43
40	3-4	35
21	4-6	18
<u>4</u>	<u>over 6</u>	<u>4</u>
114		100

Total annual damages sustained by fishing vessels, directly attributable to the shoaling in Chatham Bars Inlet, were estimated on the basis of discussions with the harbormaster, fishermen, marina owners, owners of repair facilities, and marine insurers. About 60 vessels per year incur an average of \$500 in damages for a total of \$30,000. Since the improvements are estimated to be 50% effective in reducing these damages, the net savings is estimated to be \$15,000 annually.

c. Transportation Savings. When a storm suddenly comes up, or if a boat cannot get back into Chatham Harbor because of low water over the bar, it has to go to either Chatham Stage, Saquatucket, or Harwich Port Harbors, distances of 20, 22 and 24 nautical miles, respectively. Additional expenses are incurred for crew wages, fuel, dockage, truck

transport of goods to Chatham, for the return boat trip to Chatham Harbor at some later date, and lost time spent with engines idling while waiting for the proper tidal conditions to allow passage over the bars. Transportation and labor costs amount to \$6,000 and fuel costs at 70¢ per gallon (June 1979 prices) amount to \$18,000 for a total of \$24,000. Therefore, a 50% reduction in expenses amounts to an estimated benefit of \$12,000 annually.

d. Reduction in Buoy Maintenance. Information from the Chatham Harbormaster, who is charged with the responsibility for buoy maintenance, provided the basis for this benefit category. A 33% reduction in the current annual cost of \$40,000 for the buoy maintenance program, plus the elimination of small markers in the breach at an annual cost of \$1,000, results in a total anticipated savings of \$14,200 annually.

e. New Shellfish Beds. Materials for the sand dike would be obtained from a 100 acre area west of Monomoy Island as shown in Plans, B, C, and E. The Chatham Shellfish Warden estimates that the 100-acre area, up to six feet deep, could be repropagated with shellfish and a yield of 1,000 bushels of clams; 1,500 bushels of quahogs; and 70,000 pounds of scallops could be realized annually. The value would be: 1,000 bushels of clams @ \$32.00 = \$32,000; 1,500 bushels of quahogs @ \$40.00 = \$60,000; and 70,000 pounds of scallops @ \$3.00 = \$210,000, for an annual benefit of \$302,000, for a bumper year. A value of \$100,000 was conservatively used as an average annual benefit. However, the U.S. Fish and Wildlife Service was hesitant about substantiating the shellfish benefits in the area and no benefits could be claimed at this time. See the Fish and Wildlife letter in Appendix A.

f. Reduction in Stage Harbor Maintenance Dredging. Maintenance dredging of the relocated entrance to Stage Harbor was required from 1965 thru 1978. Shoaling due to the Morris-Monomoy breach amounted to about 7,000 cy or about \$35,000 annually. If we assume 50 percent of the shoaling will be stopped when the breach is closed, an annual savings of \$17,500 would be realized. It is estimated that one half of the savings would accrue with Alternative A, because the breach will eventually close under natural conditions.

g. Recreational Boating. Recreational boating benefits which would be expected to accrue to each of the alternative plans of improvement are as follows:

Plan A. This plan would provide a new inlet through Nauset Beach. If the inlet stays open, larger size recreational boats could use the inlet, but the shallow interior channels would still restrict full use of the waterway. Therefore, no significant recreational benefits will accrue to this plan. In addition, if the new inlet stays open, the Monomoy-Morris Island breach would probably close thereby prohibiting use by smaller boats and will result in a negative benefit of \$48,850. See Table 3.

TABLE 4  
RECREATIONAL BENEFITS - EXISTING FLEET

STUDY: Chatham Bars Inlet - Plan C, 1979 Values

SEASON: 120 Days

TYPE OF CRAFT AND LENGTH (Feet)		No. of Boats	DEPRECIATED VALUE		PERCENT RETURN			VALUE \$	ON CRUISE			
			Average \$	Total \$	Ideal	% of Ideal			Gain	Avg. Days	% of Season	Value \$
						Present	Future					
RECREATIONAL FLEET												
Outboards	10-14	190	3025	574750	14	100	100					
	15-20	657	3960	2601720	13	100	100					
	21&Up	95	7205	684475	13	90	100	1.30	8900			
Sterndrive	15-20	20	6435	128700	12	100	100					
	21-25	23	10120	232760	11	90	100	1.10	2560			
	26&Up	2	19965	39930	10	85	100	1.50	600			
Inboards	15-20	15	7260	108900	12	100	100					
	21-30	102	14850	1514700	12	90	100	1.20	18175	14	9	1635
	31-40	70	40645	2845150	11	85	100	1.65	46945	19	12	5635
	41-50	15	96360	1445400	10	85	100	1.50	21680	32	20	4335
	51&Up	5	192390	961950	9	80	100	1.80	17315	48	30	5195
Cruising Sailboats	15-20	35	4730	165550	8	100	100					
	21-30	200	14905	2981000	8	90	100	.80	238480	8	5	11925
	31-40	60	41085	2465100	7	85	100	1.05	25885	26	16	4140
	41&Up	7	81180	568260	6	80	100	1.20	6820	40	25	1705
Daysailers	8-15	30	1320	39600	12	100	100					
	16-20	60	3245	194700	12	100	100					
	21-25	35	6105	213675	11	90	100	1.10	2350	8	5	120
	26&Up	5	11605	58025	10	85	100	1.50	870	40	25	220
TOTALS		1625							390,580			34,910

Annual Benefit = \$390,580 - \$34,910 = \$355,670

TABLE 3  
LOST RECREATIONAL BOATING BENEFITS

STUDY: Chatham Bars Inlet - Plans A & B, 1979 Values

SEASON: 120 Days

TYPE OF CRAFT AND LENGTH (Feet)		No. of Boats	DEPRECIATED VALUE		PERCENT RETURN			VALUE	ON CRUISE			
			Average \$	Total \$	Ideal	% of Ideal		Loss	\$	Avg. Days	% of Season	Value \$
RECREATIONAL FLEET												
Outboards	10-14	190	3025	574750	14	100	90	1.40	8045			
	15-20	657	3960	2601720	13	100	90	1.30	33820			
	21&Up	95	7205	684475	13	100						
Sterndrive	15-20	20	6435	128700	12	100	90	1.20	1545			
	21-25	23	10120	232760	11	100						
	26&Up	2	19965	39930	10	100						
Inboards	15-20	15	7260	108900	12	100	90	1.20	1305			
	21-30	102	14850	1514700	12	100					9	
	31-40-	70	40645	2845150	11	100					12	
	41-50	15	96360	1445400	10	100					20	
	51&Up	5	192390	961950	9	100					30	
Cruising Sailboats	15-20	35	4730	165550	8	100	90	.80	1325			
	21-30	200	14905	2981000	8	100					5	
	31-40	60	41085	2465100	7	100					16	
	41&Up	7	81180	568260	6	100					25	
Daysailers	8-15	30	1320	39600	12	100	90	1.20	475			
	16-20	60	3245	194700	12	100	90	1.20	2335			
	21-25	35	6105	213675	11	100					5	
	26&Up	5	11605	58025	10	100					25	
TOTALS		1625							- 48,850			

Annual Loss = -\$48,850

TABLE 5  
RECREATIONAL BENEFITS - NEW BOATS ADDED  
(within 25 year period)

STUDY: Chatham Bars Inlet - Plan C, 1979 Values

SEASON: 120 Days

TYPE OF CRAFT AND LENGTH (Feet)	No. of Boats	DEPRECIATED VALUE		Ideal	PERCENT RETURN			VALUE \$	ON CRUISE		
		Average \$	Total \$		% of Ideal		Avg. Days		% of Season	Value \$	
					Present	Future					Gain
RECREATIONAL FLEET											
Outboards 10-14				14							
15-20				13							
21&Up	15	7205	108075	13		100	13	14050			
Sterndrive 15-20											
21-25	3	10120	30360	11		100	11	3340			
26&Up				10							
Inboards 15-20				12							
21-30	17	14850	252450	12		100	12	30295	14	9	2725
31-40	11	40645	447095	11		100	11	49180	19	12	5900
41-50	2	96360	192720	10		100	10	19270	32	20	3855
51&Up				9						30	
Cruising 15-20				8							
Sailboats 21-30	34	14905	506770	8		100	8	40540	8	5	2030
31-40	9	41085	369765	7		100	7	25885	26	16	4140
41&Up				6						25	
Daysailers 8-15				12							
16-20				12							
21-25	4	6105	24420	11		100	11	2685	8	5	135
26&Up				10						25	
TOTALS		95						185,245			18,785

Net Annual Benefit = \$185,245 - \$18,785 = \$166,460

\$166,460 x .48523 = \$80,788

say \$80,790

TABLE 6  
RECREATIONAL BENEFITS - TRANSIENT BOATS

STUDY: Chatham Bars Inlet - Plan C, 1979 Values

SEASON: 120 Days

TYPE OF CRAFT LENGTH (Feet)	No. of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE	ON CRUISE		
		Average \$	Total \$	Ideal	% of Ideal		Gain	\$	Avg. Days	% of Season	Value \$
					Present	Future					
RECREATIONAL FLEET											
boards 10-14				14							
15-20				13							
21&Up	3	14850	44450	13	0	100	100	5778		12	693
ndrive 15-20											
21-25				11							
26&Up				10							
boards 15-20				12							
21-30				12						9	
31-40				11						12	
41-50				10						20	
51&Up				9						30	
ising 15-20				8							
lboats 21-30				8						5	
31-40				7						16	
41&Up				6						25	
sailers 8-15				12							
16-20				12							
21-25				11						5	
26&Up				10						25	
TOTALS											
								5,778			-693

\$5,778 - \$693 = \$5,085

TABLE 7  
RECREATIONAL BENEFITS - FLEET EXPANSION  
(Replacement of Commercial Boats within 1 to 3 years)

STUDY: Chatham Bars Inlet - Plan F, 1979 Values

SEASON: 120 Days

TYPE OF CRAFT LENGTH (Feet)	No. of Boats	DEPRECIATED VALUE		Ideal	PERCENT RETURN			VALUE	ON CRUISE		
		Average \$	Total \$		% of Ideal	Gain	\$	Avg. Days	% of Season	Value \$	
											Present
RECREATIONAL FLEET											
boards 10-14	14	3025	42350	14		100	14.00	5930			
15-20	46	3960	182160	13		100	13.00	23680			
21&Up	7	7205	50435	13		90	11.70	5900			
ndrive 15-20	2	6435	12860	12		100	12.00	1545			
21-25	2	101120	202240	11		90	9.90	20020			
26&Up				10							
boards 15-20	2	7260	14520	12		100	12.00	1740	14		155
21-30	10	14850	148500	12		90	10.80	16040	19	9	1925
31-40	5	40645	203225	11		85	9.35	19000	32	12	3800
41-50	2	96360	192720	10		85	8.50	16380	48	20	4915
51&Up				9						30	
ising 15-20	2	4730	9460	8		100	8.00	955			
ilboats 21-30	14	14905	208670	8		90	7.20	15025	8	5	750
31-40	2	41085	82170	7		85	5.95	4890	26	16	780
41&Up				6						25	
sailers 8-15	2	1320	2640	12		100	12.00	315			
16-20	2	3245	6490	12		100	12.00	780			
21-25	2	6105	12210	11		90	9.90	1220	8	5	60
26&Up				10						25	
TOTALS	114							133,420			12,385

$$\$133,420 - \$12,385 = \$121,035$$

$$\text{Annual Benefit} = \$121,035 \times .93470 = \$113,130$$

Plan B. This plan would create a new inlet through Nauset Beach and close the Monomoy-Morris Island breach with a sand dike, which will also eliminate small boat passage between Chatham Harbor and Chatham Roads. The negative annual benefit of this plan is also \$48,850, as shown in Table 3.

Plan C. This plan would also recreate a new inlet through Nauset Beach. In addition, a sand dike would be constructed from Nauset Beach to Monomoy Island and a cross-channel dredged between Chatham Harbor and Chatham Roads. Benefits of \$355,670 could be expected for boats currently moored throughout the area. Benefits of \$80,790 could be expected for new boats and benefits of \$5,085 could be expected for transient boats, for a total of \$441,570. See Tables 4, 5, & 6.

Plan D. As there would be no improvements with this alternative, no benefits were estimated. Deteriorating inlet conditions would result in a loss of existing benefits, however.

Plan E. This plan would only provide a dike closure between Monomoy and Morris Islands, which would eliminate the use of the existing breach by some of the local recreational boats. No significant increase in recreational boating use of the Chatham Bars Inlet is anticipated. Therefore, there would be a negative benefit of \$48,850.

Plan F. This plan relocates the commercial fishing fleet to other harbors. Additional recreation benefits might be anticipated by replacing the 114 fishing vessels currently anchored near Aunt Lydias Cove with 114 recreational crafts. The anticipated benefit would be \$121,035 as shown in Table 7. The loss of the commercial fleet would, of course, be a negative benefit and would exceed the recreational benefit by a large margin, therefore, there would be an overall negative benefit.

The comparison of benefits for the alternatives are shown in Table 8.

TABLE 8  
COMPARISON OF ANNUAL BENEFITS

BENEFITS	PLAN A	PLAN B	PLAN C	PLAN D	PLAN E
1. Increased Finfish	199,500	199,500	199,500	0	199,500
2. Boat Damages	15,000	15,000	15,000	0	15,000
3. Trans. Savings	12,000	12,000	12,000	0	12,000
4. Buoy Maintenance	14,200	14,200	14,000	0	14,200
5. New Shellfish	0	0	0	0	0
6. Stage Hbr. Maint.	8,800	17,500	17,500	0	17,500
7. Rec. Boating	(-48,900)	(-48,900)	441,570	(-48,900)	(-48,900)
TOTALS	\$200,600	\$209,300	\$699,570	(-48,900)	\$209,300

## 18. Benefit Cost Comparison

A summary of the benefit cost comparisons is shown in Table 9.

TABLE 9  
BENEFIT COST COMPARISONS

Plan	Project Cost	Annual Charges	Annual Benefits	B.C.R.
A	\$1,912,000	\$170,000	\$200,600	1.20*
B	4,856,000	457,500	209,300	0.46*
C	6,656,000	797,700	669,570	0.89*
D	0	0	0	0
E	3,109,000	305,200	209,300	0.69*
F	(Not Estimated)	-	-	-

\* Does not include inlet maintenance.

## 19. Environmental Impacts.

A field investigation of the proposed artificial inlet and the dredge and dike areas was made by NED environmental personnel. The benthic populations were identified and a letter report with bottom photographs was prepared.

The most significant impact to the environment would be the construction of the sand dike closure between Monomoy and Morris Islands.

Dredging of the inlet and channel, and borrow area, shown in PLANS A, B, and C, would affect both marine and terrestrial organism on the sound side, but would only be temporary in nature, as the existing colonies will reestablish themselves quickly. Suspended sediments will also cause temporary turbidity in the area for a short period of time.

Disposal of the dredged materials on the backside of Nauset Beach and the bottom of Chatham Bars Inlet and Morris-Monomoy Breach will cover the existing small amount of marine biota. However, new colonies are expected to reestablish quickly, especially in the lee of the sand dikes.

Plan E appears to have the least environmental impact to the area as it will not materially alter the the existing ecology in Pleasant Bay.

Planting of beach grass on the sand dikes and restoring the Nauset Beach dunes will have a beneficial effect to both the environment and aesthetics.

## 20. Coordination with Others

The alternative plans were reviewed by three coastal processes experts and the Corps of Engineers' Coastal Engineering Research Center.

The U.S. Bureau of Commercial Fisheries, the U.S. Fish and Wildlife Service and the Massachusetts Division of Marine Fisheries were contacted for fish catch statistics.

The Chatham Harbormaster and the shellfish warden were periodically consulted, as well as the selectmen and fishermen, during the course of the study.

A meeting discussing the results of our findings and recommendations was held with the Chatham Selectmen, harbormaster, shellfish warden, Chief of the Chatham Coast Guard Station, and local fishermen in October 1978. They concurred with our findings and selected plan of improvement, which is described below.

## 21. Selected Plan of Improvement

Although Plan A indicates a favorable Benefit-Cost Ratio, it was dropped from further consideration, because there is no reasonable assurance that the tidal prism will be fully diverted through the new inlet, and a likely possibility that the inlet would close soon after it was dredged.

A Mathematical Model analysis of Plan E indicated a 20% increase in inlet flow into Chatham Harbor and aided in selecting Plan E as the recommended plan of improvement. In addition to the improved hydraulics, Plan E was also selected for feasibility, maintenance, environment, ecology, economics, and local acceptance. The selected plan consists of the following:

- a. A 6,000 foot long sand dike closure between Morris Island and Monomoy Island. A top width of 50 feet at elevation +13.0 feet, MSL; sideslopes 1 on 15 to MHW, 1 on 20 to MLW and 1 on 30 below MLW. The top and side slope would be planted with beach grass, beginning at elevation +7.0 MLW.
- b. An extensive dune restoration program on Nauset Beach, extending from opposite Chatham Lighthouse to Little Pochet Island.

The fill material for the sand dike would be obtained from a 100-acre area behind Monomoy Island in Nantucket Sound (Chatham Roads). The area could later be seeded with clams, scallops and quahogs for future commercial harvesting by local interests.

The proposed semistructural plan would substantially reduce shoaling in the Stage Harbor entrance channel and prevent the diversion of flood and ebb tides into Nantucket Sound, thereby increasing the tidal prism in Chatham Harbor and Pleasant Bay, and provide more interchange of water to scour a natural inlet channel to the ocean.

The project life of the proposal is estimated to be 25 years. The cost estimate and annual charges are shown in Table 10.

TABLE 10  
PLAN E COST ESTIMATE  
(June 1979)

Description	Estimated Quantity	Unit	Unit Cost	Estimated Amount
1. Mob and Demob	1	job	L.S.	\$ 100,000
2. Dredging of Fill	750,000	c.y.	\$2.75	2,063,000
3. Shape Dike Slopes	188,000	c.y.	0.50	94,000
4. Grass Plantings	144,000	s.y.	0.50	72,000
		First Cost		\$2,329,000
		Contingencies 15%		349,000
				\$2,678,000
		E&D 8%		214,000
		S&A 7%		187,000
				\$3,079,000
		Nav. Aids		0
		Local Costs		30,000
				\$3,109,000
		TOTAL PROJECT COST		\$3,109,000
		ANNUAL CHARGES (6-7/8% - 25 years)		
<u>Federal</u>		I&A (\$3,079,000 x 0.08484)		\$ 261,200
		M&O (Sand Dike & Beach Grass)		38,000
				\$ 299,200
<u>Non-Federal</u>		I&A (\$30,000 x 0.08484)		\$ 2,500
		M&O (Dune Resoration)		3,500
				\$ 6,000
		TOTAL ANNUAL CHARGES		\$ 305,200

## 22. Required Aids to Navigation

No additional Federal aids to navigation would be required. Local aids would decrease in time and it is anticipated that less time would be spent on moving and repairing the needed buoys.

### 23. Apportionment of Costs.

The navigation improvements in the selected plan are basically commercial in nature. Therefore, the cost of dredging, building the sand dike, planting of beach grass and dike, and grass maintenance will be a Federal responsibility. The Federal cost is estimated to be \$3,079,000 and the annual charges would be \$298,200.

Rebuilding the sand dunes on Nauset Beach would be a local responsibility. Approximately 2.4 miles of standard snow fence would be required. The estimated cost of two lifts of fencing is estimated to cost \$30,000. The annual maintenance would be \$6,000.

### 24. Discussion.

There is a need for commercial navigation improvements in the Chatham Bars Inlet. Structural methods of stabilizing the inlet cannot be economically justified, however, semi-structural improvements, such as closing the Monomoy Island breach, will deflect tidal flows and establish a natural navigable channel in the Chatham Bars Inlet at a nominal cost. Restoration of the Nauset Beach dunes will prevent a future breach north of Chatham Light.

If no navigation improvements are provided in the Chatham Bars Inlet, the existing problems can be expected to worsen as Nauset Beach continues to migrate to the south. A new inlet into Chatham Harbor or Pleasant Bay will probably occur as in the past, but the location and navigability of it is uncertain.

### 25. Conclusions.

On the basis of technological, economic, and environmental criteria, the proposed improvement of closing the breach between Morris and Monomoy Islands was found to be the most practical alternative to alleviate the problems at the Chatham Bars Inlet at this time.

The alternatives of moving to another harbor or providing an artificial inlet through the barrier breach were found to be impracticable or could not be economically justified.

Although the selected plan of improvement, Plan E, is feasible and practicable, it is economically unjustified and does not warrant further detailed studies.

### 26. Recommendations.

It is recommended that no further detailed studies be undertaken to improve navigation conditions in the Chatham Bars Inlet, because of the lack of economic justification at this time.

MAX. B. SCHEIDER  
Colonel Corps of Engineers  
Division Engineer, NED